UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/628,477	07/31/2000	Patrick H. Dussud	MS146913.1/40062.79-US-01	5539

7590 06/23/2003

Homer L Knearl
Merchant & Gould P C
P O Box 2903
Minneapolis, MN 55402-0903

EXAMINER	
LY, ANH	

ART UNIT	PAPER NUMBER
2172	

DATE MAILED: 06/23/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/628,477	DUSSUD, PATRICK H.	
	Examiner	Art Unit	
	Anh Ly	2172	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed on 04/03/2003 with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection.

2. Claims 1-20 are pending in this application.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-4, 11-14 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 6,289,360 issued to Kolodner et al. (herein Kolodner) in view of 5,787;447 issued to Smithline et al. (hereinafter Smithline).

With respect to claim 1, Kolodner discloses performing a plurality of garbage collection phases (mark and sweep phases: col. 2, lines 1-18), each processor performs

each of the phases on the heap dedicated to the processor using a garbage collection thread executing on the processor (collector threads to force synchronization process: col. 3, lines 25-45 and col. 5, lines 4-14); and synchronizing the processors so that all processors have completed the preceding phase prior to each processor beginning the next phase (the beginning phase and the ending phase of the mark-sweep cycle and the synchronization process is between the mark-sweep phases: abstract, col. 2, lines 57-67; also col. 3, lines 25-45 and col. 5, lines 44-61).

As to the limitation, "logically dividing the memory into a plurality of heaps, each heap dedicated to one processor for garbage collection, wherein each processor having a dedicated heap," Kolodner does not explicitly indicate that dividing the memory into a plurality of heaps.

However, Smithline discloses each of a plurality of heaps stored in a memory of a data processing system (col. 2, lines 9-15; also see abstract, lines 1-4 and col. 1, lines 9-12).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to combine the teachings of Kolodner with the teachings of Smithline so as to obtain multiple of heaps stored in the memory in the finding of a amount of free space in the memory (col. 2, lines 8-15). This combination would made the method for manipulating entries in a plurality of heaps stored in a memory, so that the entries in the heaps remain ordered across the heaps (col. 1, lines 65-67 and col. 2, lines 1-6) and for allocating the respective locations for the heaps stored in a memory (col. 2, lines 30-34). Also this made the method for eliminating

synchronization between sweep and allocating of a newly created object in a concurrent garbage collector for a heap implemented in shared memory having mark and sweet phases (Kolodner – col. 6, lines 55-67) in the memory management environment.

With respect to claim 2, Kolodner discloses for each processor performing a phase of the garbage collection process, upon completion of the phase of the garbage collection process waiting for the other processors to complete the phase of the garbage collection process (col. 10, lines 8-18 and lines 48-55); and once the other processors have completed the phase of the garbage collection process, beginning the next phase of the garbage collection process (col. 5, lines 44-61; also col. 2, lines 32-42).

With respect to claim 3, Kolodner discloses a marking phase that marks all reachable objects in memory; a planning phase that plans the relocation of the objects; a relocation phase that updates the object references based on information calculated by the planning phase; and a compaction phase that compacts the reachable objects in memory (collection mark-sweep cycle: see fig. 7; also fig. 6, col. 10, lines 8-47, see abstract and fig. 10, col. 11, lines 25-31).

With respect to claim 4, Kolodner discloses analyzing each memory object to retrieve references to other memory object; if a reference to another memory object is present, analyzing the reference information to determine which heap the referenced object is associated; analyzing the directory of the heap for the referenced object to determine a new address location of the referenced object; and updating the reference

information in the memory object (col. 10, lines 8-47, col. 11, lines 65-67 and col. 12, lines 1-12).

Claim 11 is essentially the same as claim 1 except that it is directed to a computer program product readable by a computer rather than a method ('360 of mark and sweep phases: col. 2, lines 1-18; collector threads to force synchronization process: col. 3, lines 25-45 and col. 5, lines 4-14; the beginning phase and the ending phase of the mark-sweep cycle and the synchronization process is between the mark-sweep phases: abstract, col. 2, lines 57-67; also col. 3, lines 25-45 and col. 5, lines 44-61; and 447 of col. 2, lines 9-15; also see abstract, lines 1-4 and col. 1, lines 9-12), and is rejected for the same reason as applied to the claim 1 hereinabove.

Claim 12 is essentially the same as claim 2 except that it is directed to a computer program product readable by a computer rather than a method (col. 5, lines 44-61; also col. 2, lines 32-42), and is rejected for the same reason as applied to the claim 2 hereinabove.

Claim 13 is essentially the same as claim 3 except that it is directed to a computer program product readable by a computer rather than a method (collection mark-sweep cycle: see fig. 7; also fig. 6, col. 10, lines 8-47, see abstract and fig. 10, col. 11, lines 25-31), and is rejected for the same reason as applied to the claim 3 hereinabove.

Claim 14 is essentially the same as claim 4 except that it is directed to a computer program product readable by a computer rather than a method (col. 10, lines

8-47, col. 11, lines 65-67 and col. 12, lines 1-12), and is rejected for the same reason as applied to the claim 4 hereinabove.

With respect to claim 20, Kolodner discloses a synchronizing module for synchronizing the activities performed by the garbage collection modules (col. 3, lines 25-45; also col. 2, lines 18-32).

As to the limitation, "a plurality of garbage collection modules for reclaiming unused memory objects located within the shared memory, each garbage collection module associated with a processing unit, each garbage collection module operates on a dedicated heap of memory," Kolodner does not explicitly indicate that dedicated heap of memory in the data processing system.

However, Smithline discloses each of a plurality of heaps stored in a memory of a data processing system (software or application stored information in the memory in the form of heaps: collecting of data, and as well as there is software or module to determine allocating the respective amount of required free space, unused memory in the heaps or memory: col. 2, lines 1-6; and lines 9-15; also see abstract, lines 1-4 and col. 1, lines 9-12).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to combine the teachings of Kolodner with the teachings of Smithline so as to obtain multiple of heaps stored in the memory in the finding of a amount of free space in the memory (col. 2, lines 8-15). This combination would made the method for manipulating entries in a plurality of heaps stored in a memory, so that the entries in the heaps remain ordered across the heaps (col. 1, lines

65-67 and col. 2, lines 1-6) and for allocating the respective locations for the heaps stored in a memory (col. 2, lines 30-34). Also this made the method for eliminating synchronization between sweep and allocating of a newly created object in a concurrent garbage collector for a heap implemented in shared memory having mark and sweet phases (Kolodner – col. 6, lines 55-67) in the memory management environment.

5. Claims 5-9 and 15-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 6,289,360 issued to Kolodner et al. (herein Kolodner).

With respect to claim 5, Kolodner discloses stopping executing process threads (col. 3, lines 26-28); initiating parallel marking threads (col. 11, lines 5-16), in each processing unit associated with a heap, wherein one thread executes within each processing unit and wherein the marking threads mark the reachable objects (col. 3, lines 5-10), in the shared memory (col. 2, lines 57-67 and col. 3, lines 1-45); upon completion of all marking threads, initiating parallel planning threads in each processing unit associated with a heap, wherein one thread executes within each processing unit and wherein each planning thread plans the new locations for objects within the associated heap (col. 6, lines 18-33, see fig. 2 and col. 8, lines 9-30); upon completion of all the planning threads, initiating parallel relocating threads in each processing unit associated with a heap, wherein one thread executes within each processing unit and wherein each relocating thread updates internal object references based on the new locations determined by the planning threads, the relocation threads updating

information for objects within the associated heap; and upon completion of all the relocating threads, initiating parallel compacting threads in each processing unit associated with a heap, wherein one thread executes within each processing unit and wherein each compacting thread updates moves objects within the associated heap to the new locations determined by the planning threads (col. 5, lines 62-67, col. 6, lines 1-7 and col. 11, lines 25-31, see figs. 9 and 10).

Kolodner also discloses planning threads, initiating parallel relocating threads in each processing unit associated with a heap, and the relocating threads, initiating parallel compacting threads in each processing unit associated with a heap based on the mutator thread allocating object, updating a node by a program thread and collector thread (col. 4, lines 3-8; col. 6, lines 18-24 and col. 8, lines 12-30).

Kolodner although teaches the threads in a multiprocessor system by on the mutator from which it mutates or change the object by marking and reclaiming the collector that the thread does not explicitly indicate.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to utilize the mutator for synchronizing between the threads in the concurrent garbage collection cycle (col. 2, lines 15-32) as taught by Kolodner because it would have made the method for eliminating synchronization between sweep and allocating of a newly created object in a concurrent garbage collector for a heap implemented in shared memory having mark and sweet phases (Kolodner – col. 6, lines 55-67) in the memory management environment.

With respect to claim 6, Kolodner discloses analyzing each memory object to retrieve references to other memory objects; if a reference to another memory object is present, analyzing the reference information to determine which heap the referenced object is associated; analyzing the directory of the heap for the referenced object to determine a new address location of the referenced object; and updating the reference information in the memory object (col. 10, lines 8-47, col. 11, lines 65-67 and col. 12, lines 1-12).

With respect to claim 7, Kolodner discloses wherein the marking threads mark objects independently of the heap boundaries (abstract, col. 10, lines 65-67 and col. 11, lines 1-25).

With respect to claims 8-9, Kolodner discloses wherein all the processing units associated with the computer system are associated with a heap and wherein the heaps comprise a contiguous set of memory objects within the shared memory (col. 4, lines 39-59 and col. 6, lines 55-60 and col. 7, lines 1-15).

With respect to claim 10, Kolodner discloses for each processing unit associated with a heap: a marking module executing a marking phase that marks reachable objects within the shared memory; a planning module for executing a planning phase that plans the relocation the memory objects within the associated heap following the marking of all reachable objects; a relocating module for executing a relocating phase that updates the object references within objects of the associated heap following the planning of the relocation; a compacting module for executing a compacting phase that moves the memory objects of the associated heap following the updating of the object references;

and a rendezvous module for determining whether all processing units in the system have completed each preceding phase before starting the next phase (collection mark-sweep cycle: see fig. 7; also fig. 6, col. 10, lines 8-47, see abstract and fig. 10, col. 11, lines 25-31; col. 3, lines 25-45 and col. 5, lines 44-61).

Kolodner also discloses planning threads, initiating parallel relocating threads in each processing unit associated with a heap, and the relocating threads, initiating parallel compacting threads in each processing unit associated with a heap, and a rendezvous module based on the mutator thread allocating object, updating a node by a program thread and collector thread (col. 4, lines 3-8; col. 6, lines 18-24 and col. 8, lines 12-30).

Kolodner although teaches the threads in a multiprocessor system by on the mutator from which it mutates or change the object by marking and reclaiming the collector that the thread does not explicitly indicate.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to utilize the mutator for synchronizing between the threads in the concurrent garbage collection cycle (col. 2, lines 15-32) as taught by Kolodner because it would have made the method for eliminating synchronization between sweep and allocating of a newly created object in a concurrent garbage collector for a heap implemented in shared memory having mark and sweet phases (Kolodner – col. 6, lines 55-67) in the memory management environment.

Claim 15 is essentially the same as claim 5 except that it is directed to a computer program product readable by a computer rather than a method (col. 2, lines

57-67 and col. 3, lines 1-45; col. 6, lines 18-33, see fig. 2 and col. 8, lines 9-30; and col. 5, lines 62-67, col. 6, lines 1-7 and col. 11, lines 25-31, see figs. 9 and 10), and is rejected for the same reason as applied to the claim 5 hereinabove.

Claim 16 is essentially the same as claim 6 except that it is directed to a computer program product readable by a computer rather than a method (col. 10, lines 8-47, col. 11, lines 65-67 and col. 12, lines 1-12), and is rejected for the same reason as applied to the claim 6 hereinabove.

Claim 17 is essentially the same as claim 7 except that it is directed to a computer program product readable by a computer rather than a method (abstract, col. 10, lines 65-67 and col. 11, lines 1-25), and is rejected for the same reason as applied to the claim 7 hereinabove.

Claims 18 and 19 are essentially the same as claims 8 and 9 except that they are directed to a computer program product readable by a computer rather than a method (col. 4, lines 39-59 and col. 6, lines 55-60 and col. 7, lines 1-15), and is rejected for the same reason as applied to the claims 8 and 9 hereinabove.

Contact Information

6. Any inquiry concerning this communication should be directed to Anh Ly whose telephone number is (703) 306-4527 or via E-Mail: **ANH.LY@USPTO.GOV**. The examiner can be reached on Monday – Friday from 8:00 AM to 4:00 PM.

If attempts to reach the examiner are unsuccessful, see the examiner's supervisor, Kim Vu, can be reached on (703) 305-4393.

Any response to this action should be mailed to:

Commissioner of Patents and Trademarks

Washington, D.C. 20231

or faxed to: (703) 746-7238 (after Final Communication)

or: (703) 746-7239 (for formal communications intended for entry)

or: (703) 746-7240 (for informal or draft communications, or Customer Service Center, please label "PROPOSED" or "DRAFT")

Hand-delivered responses should be brought to Crystal Park II, 2121 Crystal Drive, Arlington, VA, Fourth Floor (receptionist).

Inquiries of a general nature or relating to the status of this application should be directed to the Group receptionist whose telephone number is (703) 305-3900.

AL
Jun 3rd, 2003

KIM VU
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2100